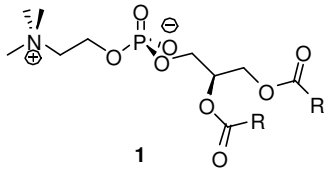
Report on the research stay of Prof. A. Studer in the laboratory of Dr. C. Chatgilialoglu at CNR in Bologna (April 2010)

Over the last decades the modification of surfaces on a micro and nanoscale has become a highly active field in the area of materials science research. The structuring of surfaces is of high interest due to the fact that the surface properties can be changed/tuned selectively. Structured surfaces can be prepared by two different strategies: "Top-down-strategies" like micro contact printing[1,2] or electron beam lithography[3] and "bottom-up-strategies" like *Langmuir-Blodgett* (LB) lithography which is depending on self assembly.

With LB lithography a well defined number of organic monolayers can be transferred on a solid substrate. The groups of *Fuchs* and *Chi* showed that striped surfaces can be obtained by using LB lithography.[4,5] An often applied molecule for the LB transfer is L-α-dipalmitoylphosphatidylcholine (DPPC, see Figure 1).



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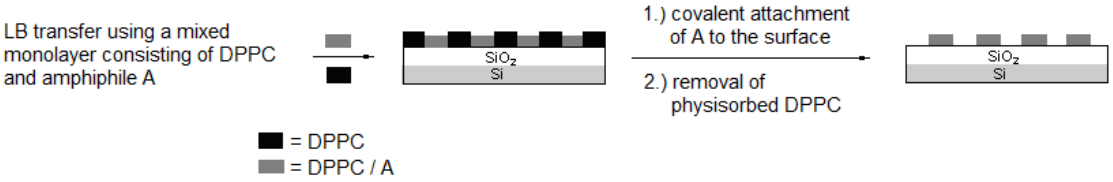
$R = -(CH_2)_{15}CH_3$

Figure 1: DPPC **1**

By using a mixture of DPPC and a second amphiphilic molecule **A** mixed monolayers can be obtained consisting of stripes of pure DPPC and interfacial stripes of a mixture of DPPC and **A**. If **A** bears an anchor function it can be bound covalently to the surface. After the covalent attachment of **A** the physisorbed DPPC can be removed by sonication so that only the stripes of the amphiphile **A** remain site specifically bound on the surface (Scheme 1).



Scheme 1: Formation of structured surfaces from mixed monolayers

In the LB transfer only amphiphilic molecules can be used. For the covalent attachment and the later modification of the surfaces bifunctional molecules are needed. The molecule must fulfill the following requirements: The anchor function for the covalent attachment to the surface must form the polar head group. Due to the amphiphilic character of the molecule the rest of the molecule has to be hydrophobic including the functional group for the later surface modification. The general concept for the synthesis of possible target compounds is shown in Figure 2.

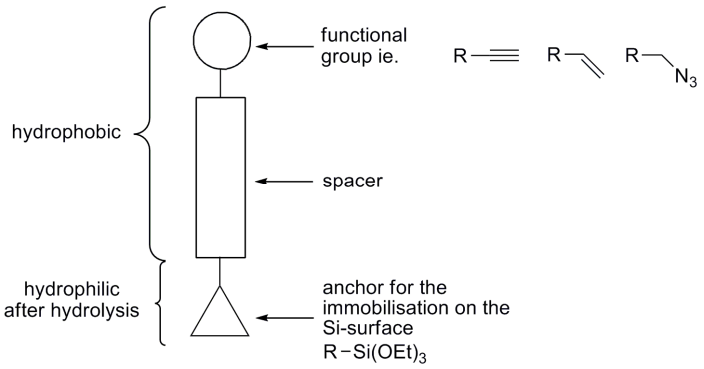


Figure 2: Concept for the synthesis of amphiphilic target molecules

For the covalent attachment to oxidized silicon surfaces triethoxysilanes have been used in the group of Studer. Triethoxysilanes can be easily generated from terminal double bonds by hydrosilylation. In comparison to the more reactive trichloro and trimethoxysilanes they are more stable and far easier to handle.
During the stay in Bologna, I was discussing with Dr. C. Chatgilialoglu, who is an expert in the field of lipidomics, new lead structures that obey the concept presented in Figure 2. Possible lead structures based on lipids were designed. Synthetic plans to modify these lipid-based amphiphiles, according to Figure 2, in order to be used in LB-lithography with subsequent covalent attachment to the surface were constructed/designed. Hence, the lipid-based amphiphiles have to bear a triethoxysilyl moiety at one terminus. The German team and the Italian team agreed to initiate collaboration in this field. Based on the discussion in Bologna, novel amphiphiles will be prepared in Münster in the near future. Prof. Studer will return to Bologna in June 2010 to discuss first results. Moreover, it is planned that Dr. Chatgilialoglu will go to Münster in 2011 to further intensify this joint project between these two research groups. Hence, the stay in Bologna was the basis for more intensive collaboration.
In addition, during the time in Bologna Dr. Chatgilialoglu and I were intensively working on a handbook of free radical chemistry. We will edit a handbook comprising 4 Volumes including around 75 chapters. That handbook will for the first team cover the broadness of free radical chemistry (basic concepts, biology, medicinal aspects, synthesis, and materials science). It will be published by Willey-Interscience and a meeting with the managing editor of Wiley for that project, Dr. Martin Röthlisberger, was held in Bologna. In Bologna, we contacted many authors regarding that book project. The book will appear by the end of 2011 (online version around mid 2012).
To sum up, I can state that my research stay in Bologna was very successful. I enjoyed the research environment in Bologna a lot. I noticed a very stimulating atmosphere there.

Münster, April 27th 2010

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